

A grayscale microscopic image of plant tissue, showing a network of interconnected cells with prominent cell walls and some darker, more complex internal structures.

Advancing a Biological Paradigm for Biomass Pretreatment

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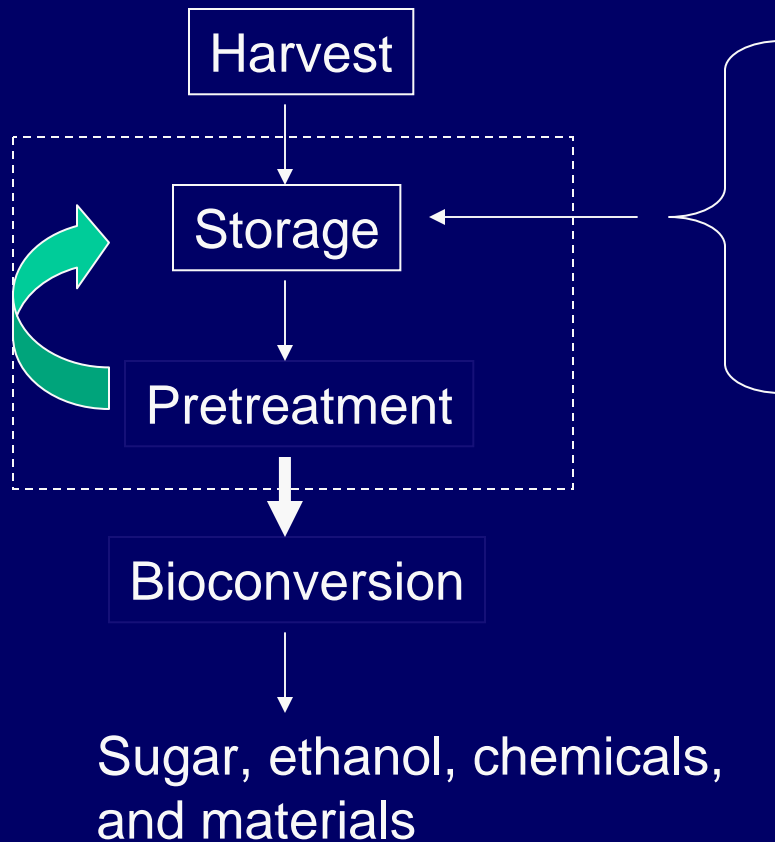
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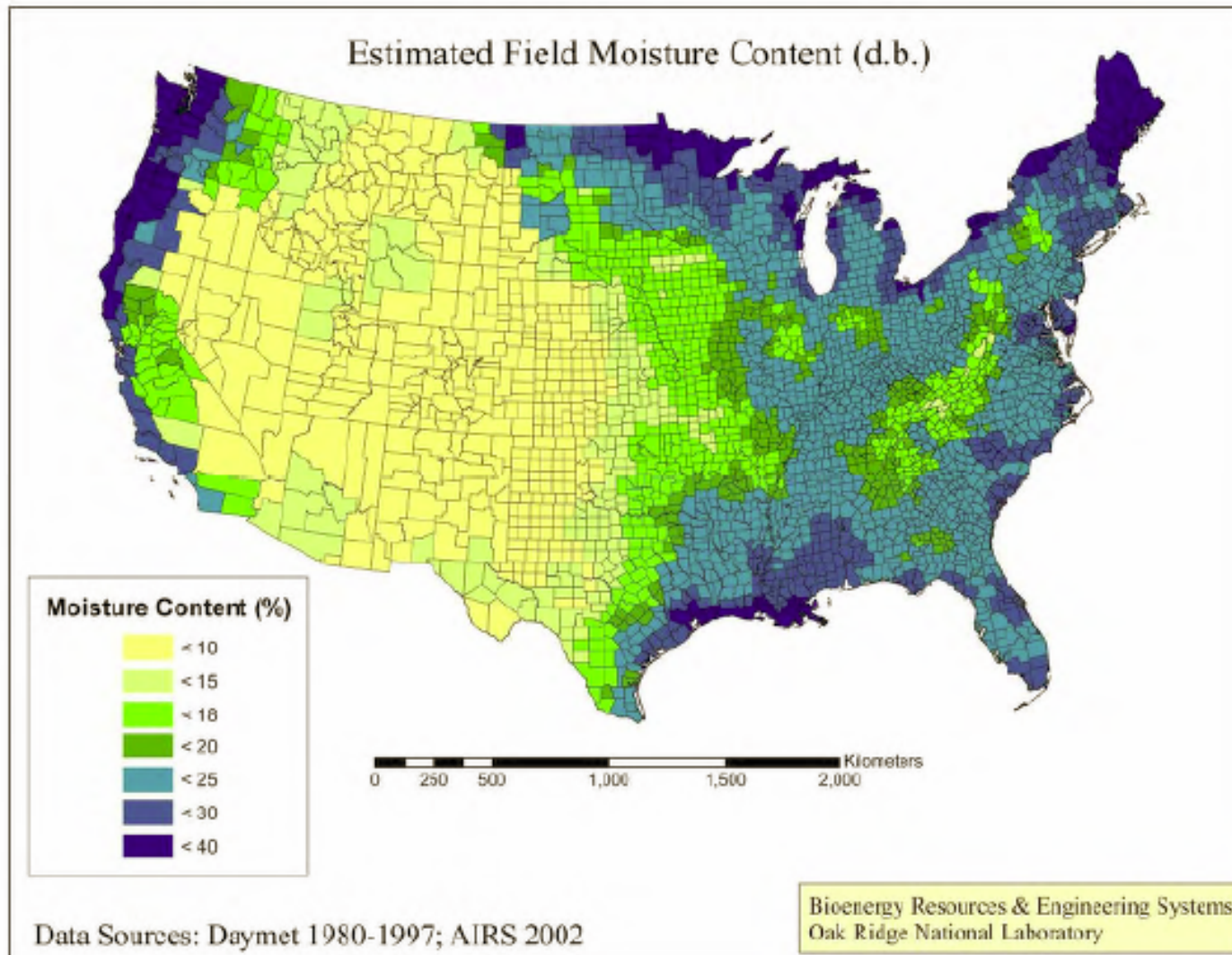
Feedstock storage challenges



- ❖ Harvested once a year
- ❖ Need long term storage of large quantities
- ❖ Minimize dry matter loss
- ❖ Eliminate risk of fire



Most Biomass is Wet



Ensiled Storage

Advantages:

- High moisture content
- Low pH for long term storage
- Synergies may allow less intensive pretreatment through hydrolysis and saccharification

Disadvantages:

- Hydrolysis products (sugar) may degrade and be lost
- Additional cost if cell wall degrading enzymes, microbes, and/or chemicals are applied additives

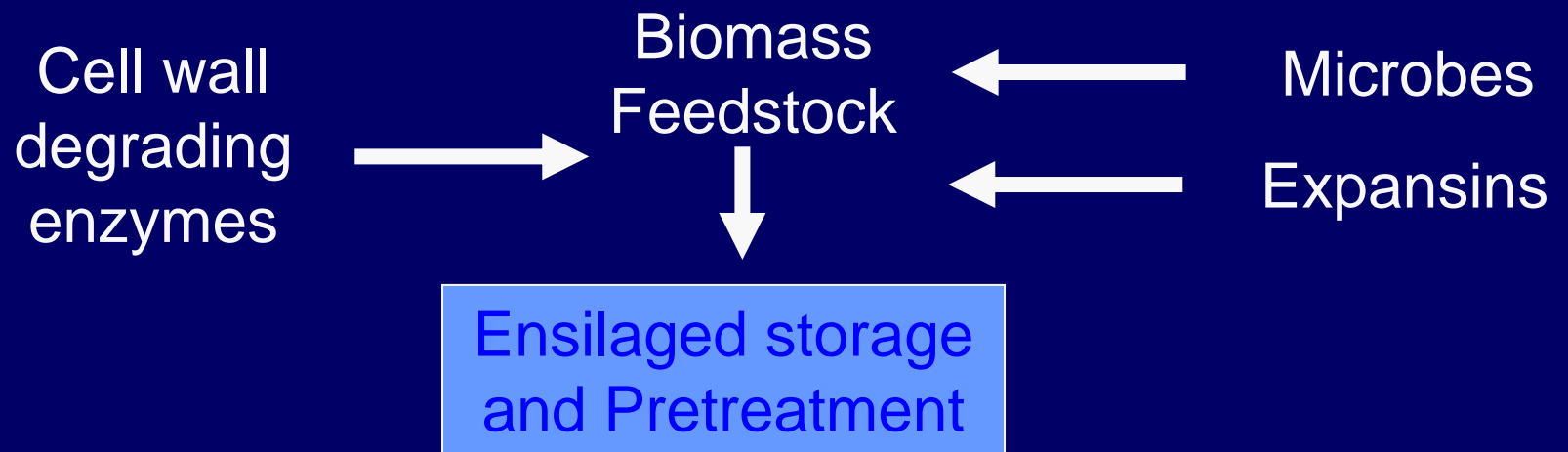


Scaleable technology

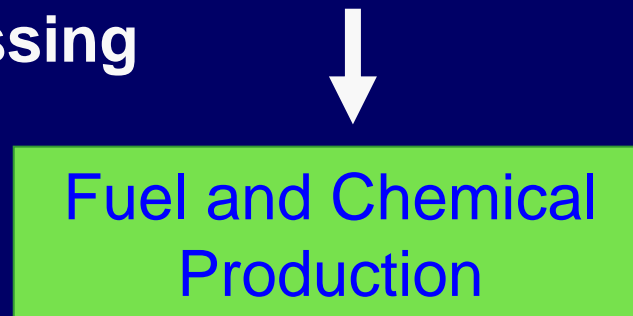


Alternative Strategies for Biocatalysis

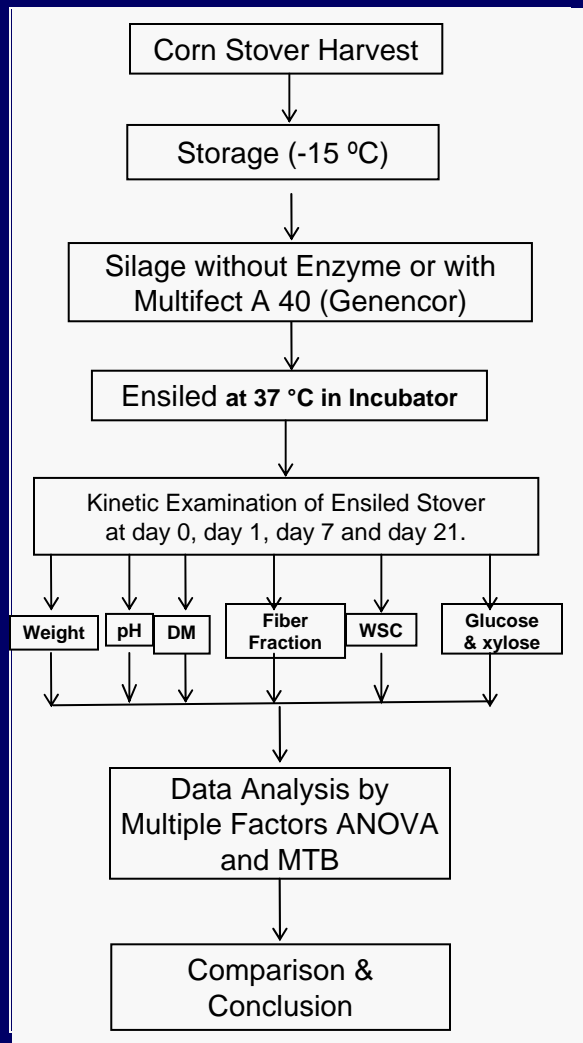
❖ Storage and pretreatment



❖ Downstream Processing



Methods



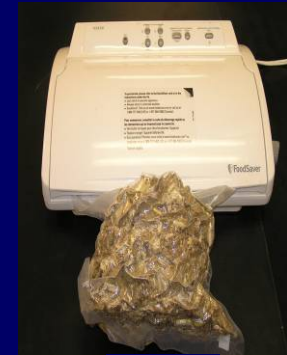
Flow chart



a



b



c



d



e



f

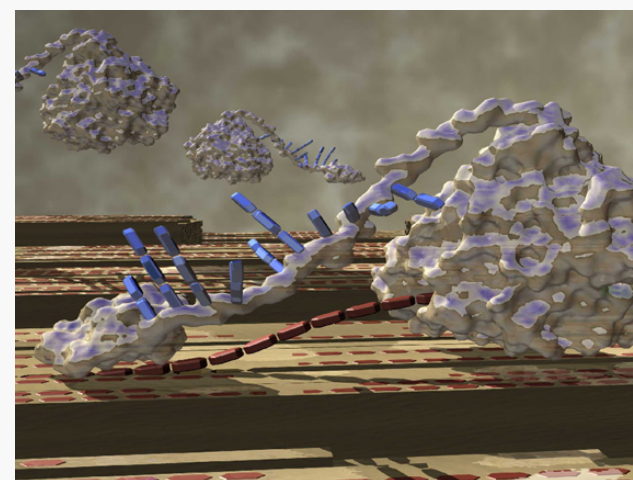
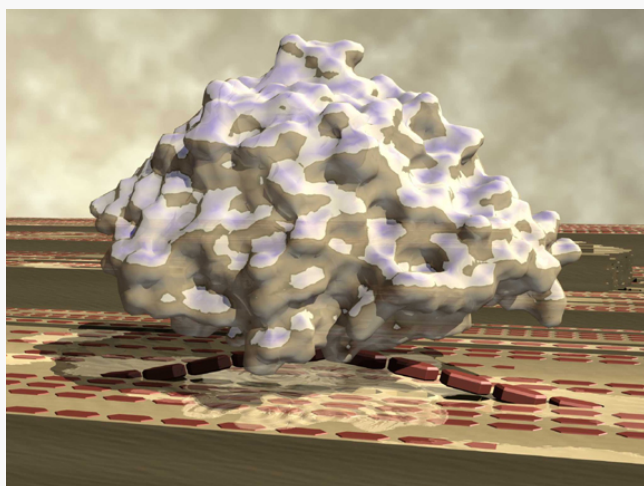


g

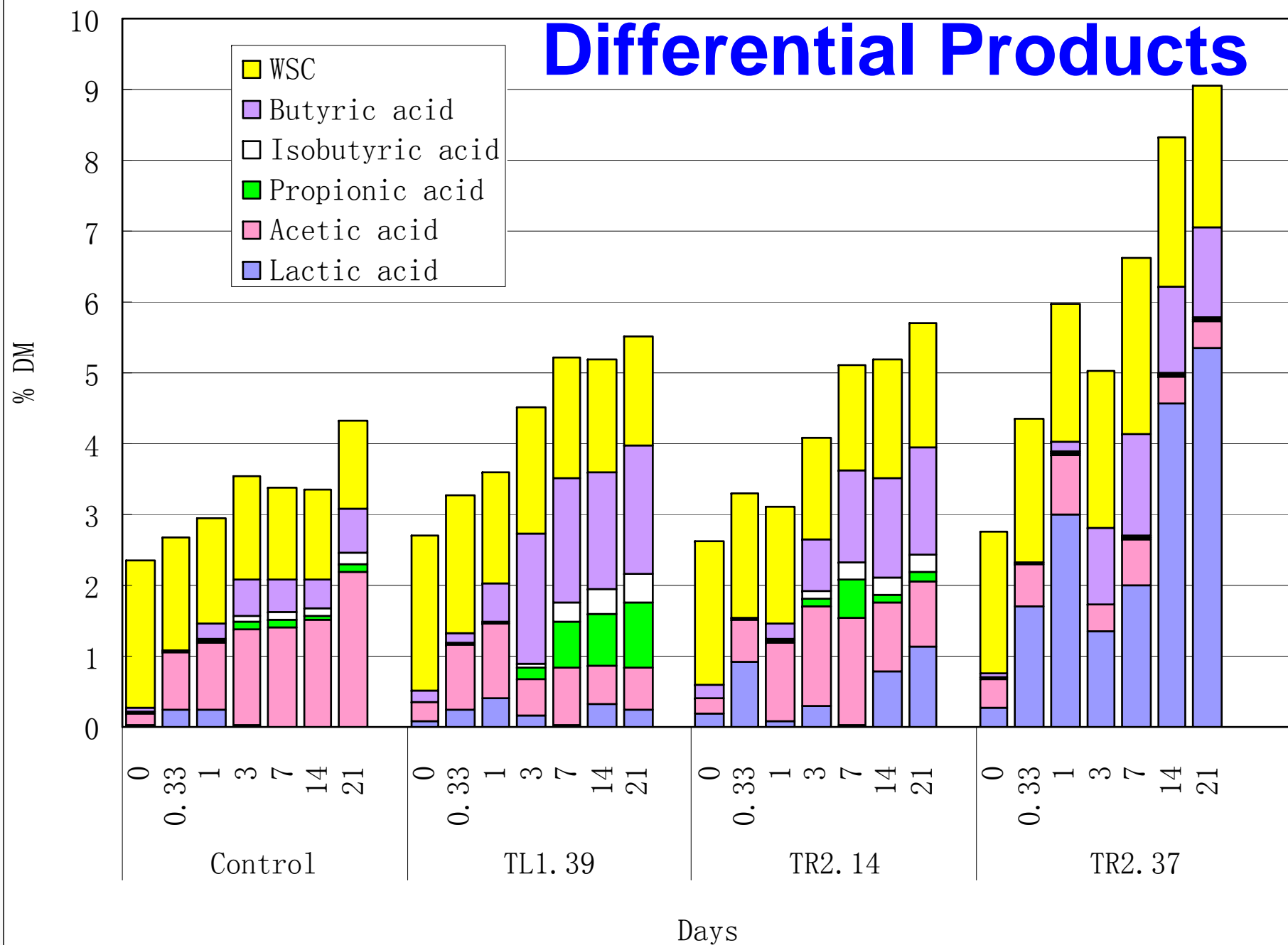
- a) Harvest Machine
- b) Harvested Field
- c) Food Vacuum sealer
- d) Incubator
- e) Fiber Analyzer
- f) Daisy II Incubator
- g) HPLC

Screening Commercial Enzyme Products

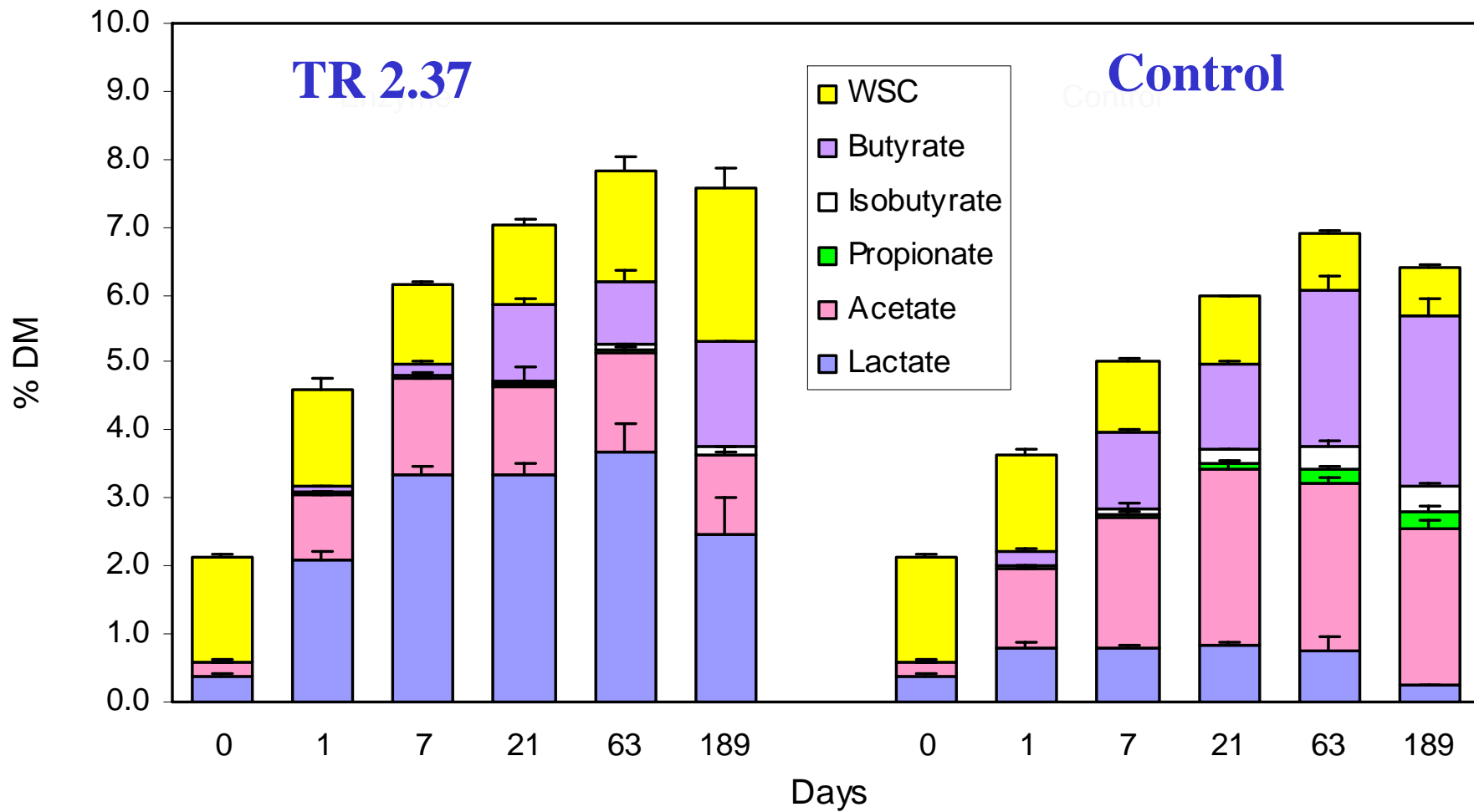
Microorganism source	Brand name	Hemicellulase	Cellulase	C:H	
<i>Aspergillus niger</i>	Enzecoxy lanase A Concertrate	24805. U/g	1904 U/g	0.08	AN0.08
	Deerland Hemicellulase	1075 U/g	384 U/g	0.36	AN0.36
<i>Trichoderma reesei</i>	Multifect xylanase	5712 U/ml	109 U/ml	0.02	TR0.02
	DeerlandCellulase TR	1219. U/g	2607 U/g	2.14	TR2.14
	Multifect CL	116 U/ml	278 U/ml	2.38	TR2.38
<i>Trichoderma longibrachiatum</i>	Dyadic Xylanase 2XP	18624 U/g	5144 U/g	0.28	TL0.28
	Safizym fl300	390 U/ml	543 U/ml	1.39	TL 1.39

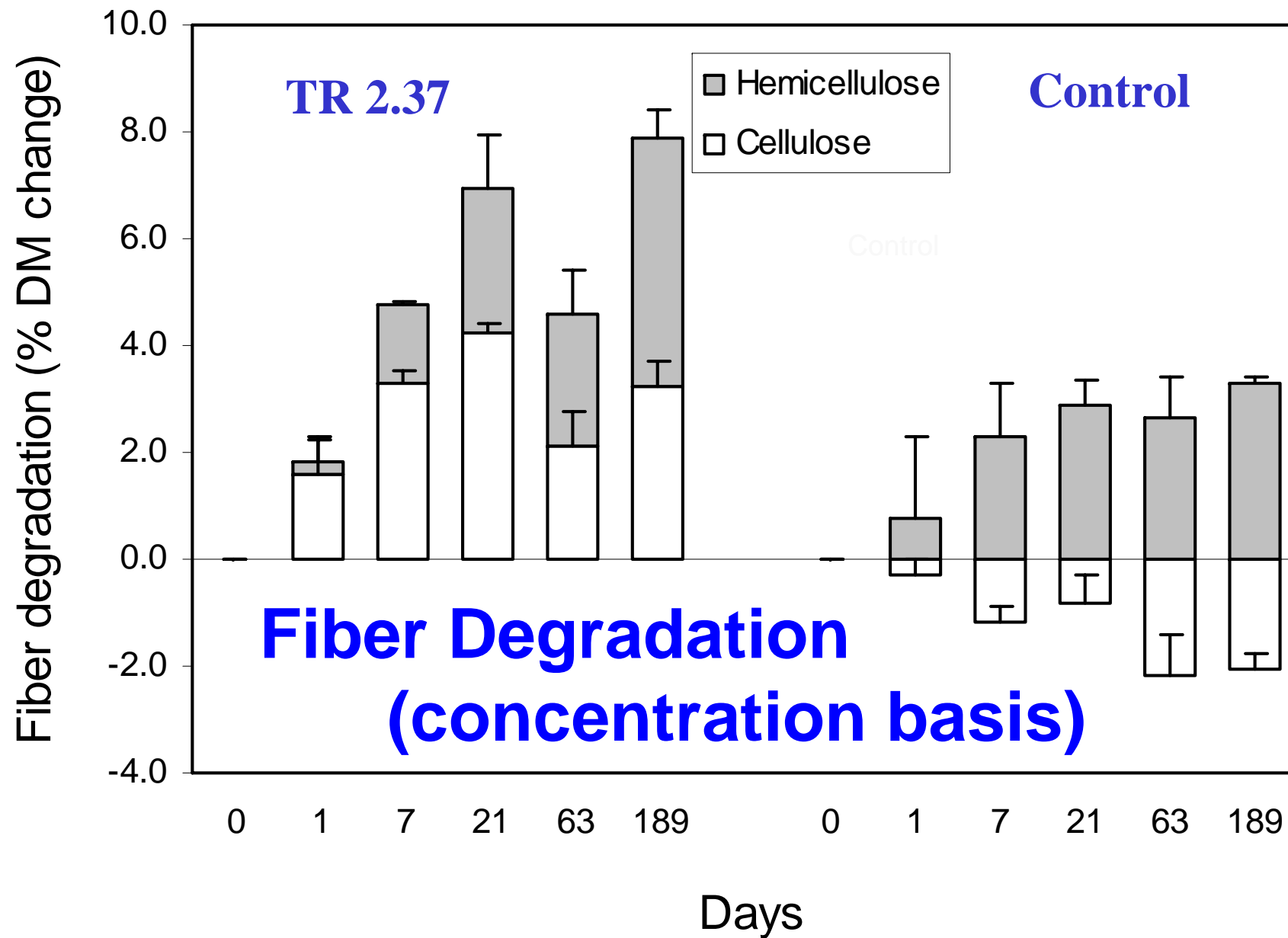


Differential Products



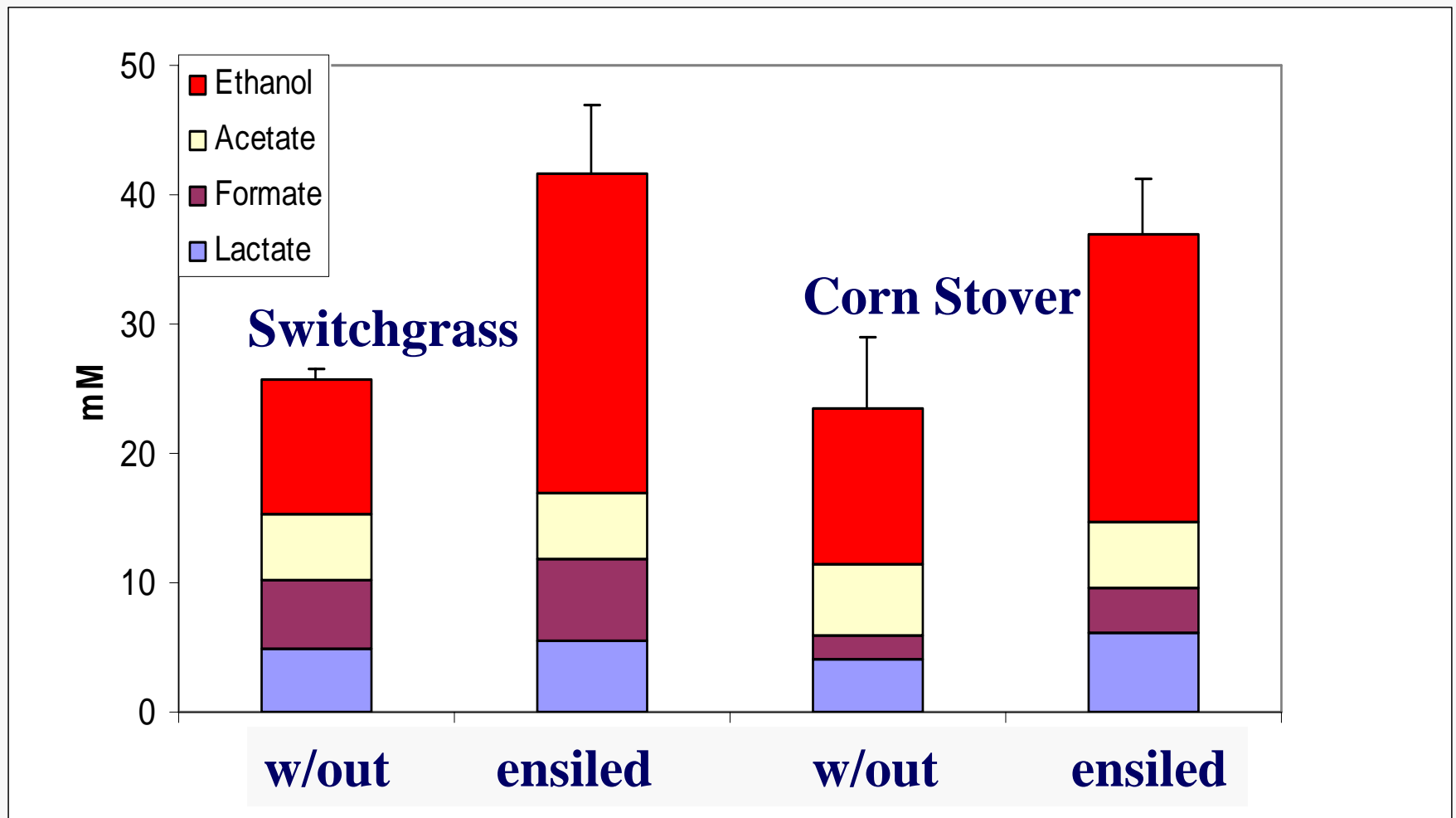
Long-term Storage Effects





Consolidated BioProcessing Results

clostridium phytofermentens

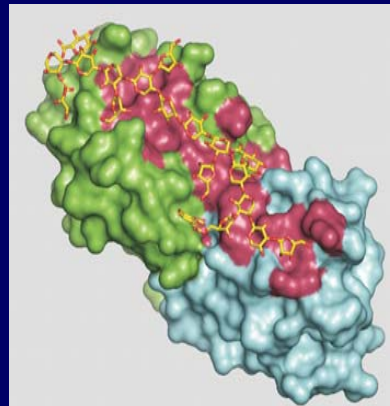


Other biocatalyst strategies

- Lignin degrading enzymes



- Expansins



- Microbe-enzyme-substrate interactions



Issues and Concerns

- How can we best generate and identify synergies with downstream processing?
- What are the upstream opportunities and synergies with plant biotechnology?
- What are the critical tradeoffs between on-farm storage/pretreatment and more centralized strategies?
- Are the energetic and economic costs of biological pretreatment competitive?